ESTCP
Cost and Performance Report

(PP-9803)

Tri-Service Dem/Val of the Pulsed Optical Energy Decoating (FLASHJET®) Process for Military Applications – Ground/Fighting Vehicle Evaluation

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COST & PERFORMANCE REPORT
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LIST OF ACRONYMS

ANAD	Anniston Army Depot
APC	Armored Personnel Carrier
DoD	Department of Defense
ECAM	Environmental Cost Analysis Methodology
ESTCP	Environmental Security Technology Certification Program
HAP	Hazardous Air Pollutant
HEPA	High Efficiency Particulate Air
HHL	Hand Held Laser
JTP	Joint Test Protocol
NESHAP	National Emission Standard for Hazardous Air Pollutants
OEM	Original Equipment Manufacturer
SERDP	Strategic Environmental Research and Development Program
TRI	Toxic Release Inventory

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Technical material contained in this report has been approved for public release.

1.0 EXECUTIVE SUMMARY

A major waste stream associated with Department of Defense (DoD) industrial maintenance facilities is toxic chemical and media blast materials associated with coating removal operations. From the 1994 Toxic Release Inventory (TRI) data for all DoD operations, coating removal operations accounted for approximately 20% of all waste (2.5 million pounds annually from a total of 11.3 million pounds total DoD waste). Chemical coating removers often contain methylene chloride, phenols, and toluene, which are classified as hazardous air pollutants (HAPs). To replace chemical coating removal processes, many facilities switched to the more environmentally preferred method of media blasting. However, media blasting increases the tonnage of coating removal hazardous waste leaving the facility. These conventional coating removal operations also have additional safety and health concerns for workers. Due to these undesirable attributes, military maintenance operations are compelled to re-evaluate current coating removal methods and search for alternatives. DoD facilities are also faced with Executive Order 13148, originally Executive Order 12856, where installations must decrease all waste disposal volumes by 50%. Additionally, DoD facilities are faced with complying with National Emission Standard for Hazardous Air Pollutant (NESHAP) regulations such as the Aerospace NESHAP. In 2004 the Miscellaneous Metal Parts and Products NESHAP regulation will be final and a section of this regulation will deal with the controlling of HAPs during coating removal activities. This will greatly impact coating removal operations involving ground and fighting vehicles.

In October 1997, the Environmental Security Technology Certification Program awarded the U.S. Army Environmental Center funding for a project to demonstrate and validate the Flash Tech, Inc. FLASHJET Coatings Removal Process on military equipment, specifically on rotary wing and ground/fighting vehicle applications. The process was sold from The Boeing Company to Flash Tech, Inc. in December 2001. These two remaining applications followed successful work on fixed wing aircraft sponsored by the Strategic Environmental Research and Development Program (SERDP). The FLASHJET process, originally patented by the McDonnell Douglas Corporation, combines the xenon-flashlamp and carbon dioxide (dry ice) pellet blasting technologies into an environmentally acceptable coatings removal process.

In this ground/fighting vehicle portion of the demonstration/validation, the FLASHJET process was evaluated on one M113 Armored Personnel Carrier in May 2000 at the Corpus Christi Army Depot (CCAD), TX. The main objective of the ground/fighting vehicle portion of the demonstration/validation was to determine if the FLASHJET process could effectively remove greater than 80% of the external surface area topcoat. Because of the size of the FLASHJET stripping head used in this demonstration/validation, less than 50% of the external surface area was stripped. With some minor engineering design changes to the FLASHJET stripping head, there is the potential for the FLASHJET process to remove more than 90% of the external surface area and greater than 50% of the internal surface area for ground/fighting vehicles.

An economic analysis was conducted to determine which coating removal process is more cost effective for an installation with a large ground/fighting vehicle overhaul workload. The conventional coating removal process, stainless steel shot blast complemented with garnet blasting, was used as the base scenario in the analysis and was compared to both the FLASHJET /hand held laser process and the robotic Waterjet/hand lance process. Based on the assumptions made in this economic analysis, the robotic Waterjet/hand lance process had a more attractive discounted

payback period than the FLASHJET /hand held laser process; however the FLASHJET /hand held laser process had a higher net present value over the Waterjet/hand lance process. Assuming a 15 year life cycle and a discount rate of 3.2%, the Waterjet/hand lance process had a discounted payback period of 8.28 years while the FLASHJET process had a discounted payback period of 8.50 years. The net present value after 15 years for the Waterjet/hand lance technology was $1,460,247 and for the FLASHJET process was $2,119,296. The approximate acquisition cost for a FLASHJET process with hand held laser is approximately $3.5M while the cost for a Waterjet/hand lance system is estimated at $2.3M.

2.0 TECHNOLOGY DEVELOPMENT

2.1 DEVELOPMENT HISTORY

The FLASHJET process evolved through several years of research and development. In 1987 the U.S. Air Force experimented with the xenon-flashlamp technology to remove coatings from aircraft substrates. The technology effectively removed the coating but the ash generated was not properly contained and the temperatures on the substrates were extremely high. In 1990 the U.S. Air Force funded another study to demonstrate the carbon dioxide pellet blasting technology for aircraft coating removal. This technology adequately removed the coating but showed the potential for damage to composite substrates.

In 1991 a team of engineers from the McDonnell Douglas Corporation, Maxwell Laboratories, and Cold Jet, Inc. combined these two previously tested technologies into one process. In 1992 the Warner-Robins Air Logistics Center funded a proof-of-concept study to demonstrate the FLASHJET process on composite substrates. A small 6" FLASHJET system was developed and successfully tested on a F-15 boron/epoxy vertical stabilizer.

Interest in the FLASHJET process evolved within the DoD after the success of the F-15 vertical stabilizer demonstration. The U.S. Air Force and U.S. Navy partnered and received funding through the SERDP to further qualify the FLASHJET process on fixed wing aircraft. In this SERDP project, high cycle fatigue testing programs were conducted on substrates commonly found on fixed wing aircraft. The objective of these testing programs was to determine potential fatigue failures possibly caused by the FLASHJET process. Results from these testing programs showed that the FLASHJET process does not cause fatigue failures on fixed wing aircraft. Based on these results, the U.S. Navy approved the use of the FLASHJET process on metallic fixed wing aircraft in 1997 and composite fixed wing aircraft in 2000. Another product developed under this SERDP project was the FLASHJET mobile manipulator. This manipulator closely resembles aircraft de-icing mechanisms; the stripping head is attached to a manipulator arm and moved directly up to the equipment for operator controlled coating removal operations. The mobile manipulator was developed for larger type aircraft that cannot fit inside a fixed gantry system stripping bay. This ESTCP project further evaluated applications that were not covered under previous FLASHJET technology demonstrations to included in the SERDP project.

2.2 PROCESS DESCRIPTION

The FLASHJET system consists of six components including the flashlamp and stripping head; the manipulator robotic arm; the computer processing cell controller; the effluent capture system; the carbon dioxide pelletizer; and the power supply for the system. The FLASHJET process can be operated using either the fixed gantry system or mobile manipulator system. The fixed gantry system was used in the CH-53 off-aircraft component and SH-60 Seahawk demonstrations.

The FLASHJET process combines the xenon-flashlamp and carbon dioxide (dry ice) pellet blasting technologies into one process. The xenon-flashlamp is the primary coatings removal mechanism. The xenon-flashlamp emits low-pressure xenon gas and creates a high intensity flash that is directly reflected to the coating causing the coating to be ablated from the surface. Pulsed light energy generated from the xenon-flashlamp pulses 4 to 6 times per second. The amount of coating ablated

is directly proportional to the amount of energy programmed into the system. The FLASHJET process can be controlled to remove as little as 0.001” or as much as 0.004” of coating during each pass. This control factor can be an asset if only topcoat removal is required.

The carbon dioxide pellet blasting portion of the process is not a direct form of coating removal. A continuous stream of carbon dioxide pellets cools and cleans the substrate, assisting in keeping the substrate at an acceptable temperature while the xenon-flashlamp ablates the coating. Additionally, the pellet stream keeps the flashlamp clear by pushing away all coating towards the effluent capture system intake. All carbon dioxide used during the FLASHJET process is captured from other industrial sources, converted into liquid carbon dioxide, shipped to the liquid carbon dioxide holding tank at the FLASHJET facility, and converted into dry ice pellets.

The effluent capture system collects all the effluent ash and organic vapors generated during the ablation process. Effluent ash is vacuumed into the effluent capture system, separated by size in a particle separator, and then captured in a series of high efficiency particulate air (HEPA) filters. Organic vapors are captured and processed through an activated charcoal tank and emitted into the atmosphere with less than 5 parts per million light hydrocarbon emission.

Operator involvement is limited compared to other traditional coating removal processes. Operating the FLASHJET process requires only two operators. During the scan path programming process, both operators program scan paths into the computer processing cell controller. Manual override of the pre-programmed scan paths is possible when required. During the stripping operation, two operators are required due to the Occupational Safety and Health Administration requirements for operating robotic processes.

Figure 1 provides a general overview of the FLASHJET process. The yellow light details the pulsed light energy generated from the xenon-flashlamp. The light is reflected down to the substrate via a polished reflector located directly behind the flashlamp. The blue stream coming from the rear of the stripping head shows the recycled carbon dioxide pellet stream that cools and cleans the substrate along with sweeping away any of the ablated coating. The green stream details all of the ablated coating and organic vapors generated during the ablation process. This stream is vacuumed into the effluent capture system. Please note that this picture does not fully represent the operation of the FLASHJET process. The optimal stand-off distance is 2.19” from the surface of the substrate. Please note that this picture was developed for information purposes only. The standoff distance in this picture is not the actual standoff distance during operation of the system.

2.3 TECHNICAL ADVANTAGES

The FLASHJET process has several advantages over other traditional coating removal technologies. One advantage is that the process generates minimal quantities of waste. Other traditional coating removal processes not only generate paint waste but also media waste. The effluent ash captured on the HEPA filters is the only waste generated in this process. The HEPA filters are tested for hazardous waste characteristics and then disposed of accordingly. Only disposing of the spent HEPA filters significantly reduces the amount of waste and costs associated with disposing waste.

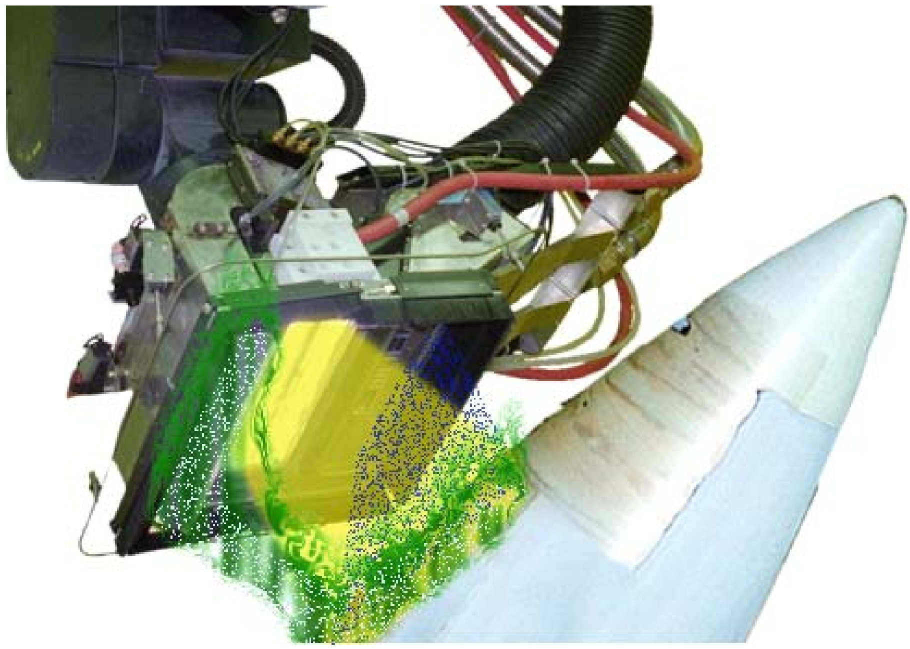

Figure 1. The FLASHJET Process.

Another advantage that the FLASHJET process has over other traditional coating removal processes is the short discounted payback period. With minimal operator involvement and waste to be disposed, the cost to operate the FLASHJET process is significantly less than other traditional coating removal processes.

The FLASHJET process also offers numerous health and safety advantages. One advantage is that operators are not directly involved in the process. In other traditional coating removal processes, several operators are involved and are suited up in personal protective equipment. Workers operating the FLASHJET process are located in a central control room shielded away from the high intensity light, noise, and effluent ash generated during the ablation process.

2.4 TECHNICAL LIMITATIONS

With the numerous advantages the FLASHJET process has to offer, there are some limitations. One limitation is the high acquisition cost for installing a FLASHJET system. The current capital cost for one FLASHJET system is approximately $3.3M. This cost is significantly higher than other traditional coating removal processes. However if the installation has a continuous workload, the system will pay for itself in a relatively short time period.

Another limitation deals with the size of the stripping head. The stripping head is 12” wide and has problems negotiating around tight corners. A secondary coating removal process, such as a portable laser coating removal system, may be required. In many cases minimal hand sanding may adequately meet the need for simple spot coating removal. The ESTCP is currently exploring the potential of a hand held laser coating removal technology (PP-200027).

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3.0 DEMONSTRATION DESIGN

3.1 DEMONSTRATION OBJECTIVES

There were four objectives of this demonstration/validation. The first objective was to successfully demonstrate the FLASHJET process on various rotary wing and ground/fighting vehicle equipment. The FLASHJET process has been tested extensively on control panels during early research but this effort demonstrated the process on fully assembled applications. The second objective was to successfully validate the FLASHJET process on rotary wing applications via a high cycle fatigue testing program. The third objective was to calculate an estimated life cycle cost per square foot for the FLASHJET process for the test equipment. The fourth and final objective was to gather valuable information during the demonstration and transfer lessons learned to DoD installations that are planning to implement the FLASHJET process.

3.2 MEASUREMENT OF PERFORMANCE

A joint group consisting of technical representatives from the affected DoD Program Managers, government engineering technical representatives, and original equipment manufacturers identified engineering, performance, and operational impact requirements for depainting processes. The group then reached a consensus on tests to qualify potential alternatives against these technical requirements, including procedures, methodologies, and acceptable criteria as applicable.

Table 1 is an excerpt from the Joint Test Protocol (JTP) developed for qualifying the process on selected equipment for this demonstration/validation. In the ground/fighting vehicle evaluation, only JTP sections 3.1.1; 3.1.2; and 3.1.3 were evaluated. The JTP can be found in Appendix A of the Demonstration Plan and Joint Test Protocol in Reference #2.

Table 1. Performance and Test Requirements.

Test Category	Test Name	JTP Section	Acceptance Criteria	References
Effectiveness Testing	Coatings Removal	3.1.1	Coating material removed completely, no damage to the underlying substrate	None
	Selective Coatings Removal	3.1.2	Topcoat layer removed, no damage to underlying primer layer	None
	Strippable Area Assessment	3.1.3	At least 80% of the surface area stripped	None
FLASHJET® Qualification Testing Program	High Cycle Fatigue Test	3.2	Varies by test	ASTM E466-96

3.3 SITE/FACILITY CHARACTERISTICS

Because of the high cost for procuring and installing a FLASHJET system, the demonstration was held in May 2000 at the newly installed aircraft FLASHJET facility at the CCAD. This facility was installed at an approximate cost of $3.3M. The facility was designed to handle rotary wing aircraft as large as one CH-47 and will be used as the primary coating removal mechanism for all rotary wing aircraft.

4.0 PERFORMANCE ASSESSMENT

4.1 PERFORMANCE CRITERIA

One M113 Armored Personnel Carrier (APC) was evaluated in this demonstration/validation. The M113 APC was evaluated under parameters set forth in the JTP. Before the sections of the M113 APC were stripped, random coating thickness measurements were taken. These coating thickness measurements gave the operator some idea of how many passes would be needed to strip a given section. Actual thickness measurements can be found in the ESTCP Final Report and Joint Test Report, Reference #3.

4.2 PERFORMANCE DATA

Five sections of the M113 APC were stripped in this evaluation. The results from the testing are highlighted in the following sections.

4.2.1 Left Side (When Looking at Front of M113)

The left side of the M113 APC had an approximate surface area of 40 ft2. Approximately 3.5 hours were required to program the scan paths into the computer processing cell controller and stripping this section took approximately 2.25 hours. The average coating thickness for this section was 0.012". The input voltage for this section was 2200V.

This section was evaluated under requirements 3.1.1; 3.1.2; and 3.1.3 of the JTP and passed all three requirements. The visual strip result for this section was 100%.

4.2.2 Right Side (When Looking at Front of M113)

The right side of the M113 APC had an approximate surface area of 40 ft2. Approximately 3.5 hours were required to program the scan paths into the computer processing cell controller and stripping this section took approximately 2.5 hours. The average coating thickness for this section was 0.0127". The input voltage for this section was 2200V.

This section was evaluated under requirements 3.1.1; 3.1.2; and 3.1.3 of the JTP and passed all three requirements. The visual strip result for this section was 100%.

4.2.3 Front Right Section

The front right side of the M113 APC had an approximate surface area of 5.5 ft2. Approximately 0.5 hours was required to program the scan paths into the computer processing cell controller and stripping this section took approximately 0.75 hours. The average coating thickness was 0.0125". Non-skid coating was also found in this section and the average coating thickness of the non-skid coating was 0.025". The input voltage for this section was 2200V.

This section was evaluated under requirements 3.1.1 and 3.1.2 of the JTP and passed all two requirements. Particular attention was given to the area that contained non-skid coating. The

non-skid coating was removed and the underlying primer remained. Requirements under Section 3.1.3 of the JTP were not evaluated due to the limited strippable surface area in this section.

4.2.4 Front Left Section

The front left side of the M113 APC had an approximate surface area of 3 ft2. Approximately 0.25 hours was required to program the scan paths into the computer processing cell controller and stripping this section took approximately 0.25 hours. The average coating thickness was 0.015”. The input voltage for this section was 2200V.

This section was evaluated under requirements 3.1.1 and 3.1.2 of the JTP and passed all two requirements. The primer was clearly visible and no damage to the underlying substrate was noted. Requirements under Section 3.1.3 of the JTP were not evaluated due to the limited strippable surface area in this section.

4.2.5 Front Middle Section

The front middle section of the M113 APC had an approximate surface area of 1 ft2. Approximately 0.25 hours was required to program the scan paths into the computer processing cell controller and stripping this section took approximately 0.5 hours. The average coating thickness was 0.0125”. The input voltage for this section was 2200V.

This section was evaluated under requirements 3.1.1 and 3.1.2 of the JTP and passed all two requirements. The primer was clearly visible with and no damage to the underlying substrate was noted. Requirements under Section 3.1.3 of the JTP were not evaluated due to the limited strippable surface area in this section.

All results from these tests may be found in the ESTCP Final Report and Joint Test Report, Reference #3.

4.3 DATA EVALUATION

The FLASHJET process can effectively remove the topcoat while leaving the underlying primer and does not damage the underlying substrate. The major concern with the process is the inability to remove coating in confined areas due to the protrusions commonly found on ground/fighting vehicles. Section 3.1.3 of the JTP specified that at least 80% of the surface area of the vehicle needed to be stripped in order to pass this requirement. On the sections of the M113 APC where JTP requirement 3.1.3 was evaluated, 100% of those sections were stripped. However if the process was evaluated on all of the exterior surface area, the FLASHJET process only stripped about 50% of the external surface area due to the inability of the FLASHJET stripping head to negotiate around and over protrusions. To overcome this problem, minor engineering design changes to the FLASHJET stripping head can be made.

4.4 TECHNOLOGY COMPARISON

The FLASHJET process was compared to other traditional coating removal technologies currently operated at DoD installations. For the M113 APC, the FLASHJET process was compared to the combination of stainless steel shot and garnet blasting.

The significant advantages of using the FLASHJET process over other traditional coating removal technologies include a faster coating removal strip rate, decreased operator requirements, and the limited quantity of hazardous waste generated in the process. Other traditional coating removal technologies typically only remove approximately 1 ft2 per minute while the FLASHJET process can remove up to 4 ft2 per minute. The FLASHJET process allows for minimal operator involvement as the process is fully robotic. Other traditional coating removal processes require a number of operators to complete the process. Finally the FLASHJET process only generates effluent ash during coating removal while other coating removal processes accumulate not only coating waste but also media waste which is used to remove the coating. All of these factors significantly reduce the total cost for coating removal operations.

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5.0 COST ASSESSMENT

5.1 COST REPORTING

Upon completion of the M113 APC demonstration, an economic analysis was conducted using the Environmental Cost Analysis Methodology (ECAM) cost estimating tool. This analysis incorporated actual data taken from the M113 APC demonstration, technical information from depainting experts, or from best engineering judgement. The ECAM spreadsheets used for this economic analysis can be found in Reference #3.

5.2 COST ANALYSIS

The Anniston Army Depot (ANAD) was used as the baseline facility for this analysis. The ANAD currently depaints in their Depot overhaul program M113 APC and M1A1 hulls using the combination of stainless steel shot and garnet blast. Each year the ANAD disposes approximately 60 tons of stainless steel shot and 100 tons of garnet blast each year. The stainless steel shot/garnet blast combination was used as the baseline process in this analysis. The FLASHJET process combined with the use of a portable hand held laser (HHL) for spot coating removal was used as one of the comparison processes. Also used in this analysis as a comparison process was the use of the robotic Waterjet technology including the use of a hand lance for spot coating removal.

Some of the assumptions used in this analysis are as follows.

- Two M113 and/or M1A1 hulls are stripped each day at the baseline facility.
- The baseline facility operates for 250 days a year.
- Steel shot/garnet blast technology is the baseline technology and considered a sunk cost.
- Discount rate is 3.2%.

Table 2 shows the approximate costs for startup costs for technologies being examined in this economic analysis.

Table 2. M113 Startup Costs.

Category	Stainless Steel Shot/ Garnet Blast	Robotic Waterjet/ Hand Lance	FLASHJET®/HHL
Purchased Equipment	$0	$2.3M	$3.5M
Training	$0	$3.2K	$3.2K
Permitting	$5K	$5K	$5K
Programming	$0	$0.3K	$0.3K

Table 3 shows the approximate costs for annual operation and maintenance for the technologies being examined in this economic analysis.

Table 3. M113 Annual Recurring Costs.

Category	Stainless Steel Shot/ Garnet Blast	Robotic Waterjet/ Hand Lance	FLASHJET®/HHL
Direct Materials	$403.8K	$27K	$28.2K
Utilities	$30K	$20K	$20K
Direct Labor	$280K	$440K	$280K
Waste Management	$90.3K	$7.5K	$7.5K
Health and Safety	$13.8K	$8.8K	$8.8K

Note the savings in hazardous waste management costs and direct labor costs avoided by implementing the FLASHJET process.

Table 4 shows the calculated 15 year internal rate of return, net present value, and discounted payback both the FLASHJET® process and Waterjet process using Steel Shot/Garnet Blast as the base technology.

Table 4. M113 Technology Economic Comparison.

Technology	NVP at 15 Years	IRR at 15 Years	Discounted Payback Period
FLASHJET®/Hand Held Laser	$2,119,296	10.7%	8.50 years
Waterjet/Hand Lance	$1,460,247	11.1%	8.28 years

The significant cost drivers for both technologies include direct labor, direct materials, and waste management. Cost savings are obtained by decreased labor, direct material, and waste management costs. Table 5 shows the estimate life cycle cost per square foot for the technologies being examined in this economic analysis.

Table 5. M113 Life Cycle Cost Analysis.

Technology	Installation Cost	Annual Costs	~Area (ft^2)	Total Depainted Each Year	LCC/ft^2
Steel Shot/Garnet Blast	$3,508,200	$817,840	350	500	$6.01
FLASHJET®/Hand Held Laser	$3,476,520	$344,570	350	500	$3.29
Waterjet/Hand Lance	$2,259,520	$476,340	350	500	$3.58

Results from this analysis show that it is more cost effective to implement the robotic Waterjet process than the FLASHJET process based on the assumptions used in this analysis. The deciding factor for the robotic Waterjet having a more attractive discounted payback period is the $1M difference in equipment acquisition costs. It should be noted that if the assumptions used in this analysis were modified, there is the potential for the FLASHJET process to be more cost effective to implement than the robotic Waterjet process. For an installation considering implementing the FLASHJET process, it is advised to conduct a comparison study of coating removal technologies to determine which coating removal method is more cost effective for the installation as discounted payback periods will vary by facility.

6.0 IMPLEMENTATION ISSUES

6.1 COST OBSERVATIONS

A limiting factor for many installations is the high acquisition cost for implementing the FLASHJET process. Currently the implementation cost for one FLASHJET system is $3.3M. This figure is significantly higher than other traditional coating removal processes. For smaller installations that do not have a large paint/depaint workload, it is not cost effective to implement the FLASHJET process. Installations that have a continuous workload are at a greater advantage and will experience significant cost avoidances if the FLASHJET process is implemented.

Installations that do implement the FLASHJET process will also decrease costs related to manpower, health and safety, and waste disposal. Traditional coating removal processes require a significant number of operators. Also traditional coating removal processes require operators to wear personal protective equipment during the depainting operation. Hazardous waste quantities are also significantly higher. These factors increase the total cost of depainting. The FLASHJET process only requires two operators present during operation, requires minimal personal protective equipment, and generates minimal waste.

6.2 PERFORMANCE OBSERVATIONS

As stated in the Performance Assessment, the FLASHJET process passed the requirements for Section 3.1.1 and 3.1.2 of the JTP but not 3.1.3 for the whole M113 APC hull. Installations that have made the decision to implement the FLASHJET process should consider redesigning the stripping head to accommodate all areas of the vehicle. Using a smaller FLASHJET stripping head will allow for more external and internal surface area of a ground/fighting vehicle to be stripped. A secondary coating removal process may be required for small spot coating removal.

6.3 SCALE-UP

The current configuration of the FLASHJET® process will meet the requirements of any installation that has a significant paint/depaint workload. For ground/fighting vehicle applications, the fixed gantry FLASHJET® system should be used to minimize operator involvement and maximize depainting time.

6.4 OTHER SIGNIFICANT OBSERVATIONS

The total time to program scan paths into the computer processing cell controller for the M113 APC was approximately 8 hours. This programming requirement should only be a one-time occurrence if programmed correctly. To make this a one-time occurrence, it is essential that each piece of equipment being stripped be placed in the same position inside the stripping bay each time. In the Apache FLASHJET stripping program in Mesa, AZ, each Apache is rolled onto pre-positioned jack stands and set in the same position each time. Pre-programmed scan paths stored in the computer processing cell controller allow the operators to strip an Apache aircraft in less than eight hours.

Since the FLASHJET process is a proprietary technology, the only avenue for implementing the technology is to contract directly with Flash Tech, Inc. The contracting process can take a very long

time so it is suggested that installations considering to implement the technology work closely with their local contracting office to determine what requirements are necessary for contracting directly with Flash Tech, Inc. Flash Tech, Inc. has also established a working relationship with the Navy contracts office at Lakehurst. All services can utilize this contract vehicle. The point of contact at the Lakehurst Naval Air Station is Keith Davis at 732-323-2243.

6.5 LESSONS LEARNED

Valuable information was noted during the demonstration. Lessons learned which will help installations implementing the FLASHJET processes are listed below.

- As stated in Section 6.2, stripping ground/fighting vehicles using the FLASHJET process will require some minor engineering changes to the stripping head. The size and other characteristics of the stripping head will be based on the types of equipment the installation depaints. Installations that choose to implement the FLASHJET process at their installation should work closely with The Boeing Company when determining requirements for designing the optimum stripping head.

- For installations implementing the FLASHJET process in humid climates, it might be necessary to have a climate controlled stripping bay. During the demonstration at the Corpus Christi Army Depot, high humidity caused the pelletizer to freeze up on several occasions. Also after the stripping was completed, the stripping bay was covered with condensation. The condensation that built up on the effluent capture system eventually dropped to the floor. A climate controlled stripping bay will eliminate condensation buildup on the system during operation.

- A routine maintenance program should be established to ensure optimal performance. The maintenance program should include periodic checks ensuring that all components of the FLASHJET system are functioning properly and that the FLASHJET stripping head is clean. It is also necessary to have an adequate number of backup supplies including fuses, xenon-flashlamps, and reflectors on site in case of an unexpected failure.

- When positioning the M113 APC or other ground/fighting vehicles inside the stripping bay, place all equipment in the same position each time. This will eliminate the need to re-program scan paths into the central computer. It is suggested that hydraulic jacks be used to lift up the equipment so that the maximum amount of surface area underneath the equipment can be stripped.

6.6 END-USER/ORIGINAL EQUIPMENT MANUFACTURER (OEM) ISSUES

In the early planning stages for this demonstration, the Program Managers of equipment being evaluated set specific testing requirements needed for full approval of the FLASHJET® process on their equipment. At the conclusion of the demonstration, engineers in the program offices evaluated the data and approved the use of the FLASHJET® process on their equipment. Approval letters from Program Managers are currently being drafted for circulation.

6.7 APPROACH TO REGULATORY COMPLIANCE AND ACCEPTANCE

The FLASHJET® process is a relatively clean coating removal process which has very little impact on environmental compliance. In order to operate a FLASHJET® system, the installation must comply with the Clean Air Act as effluent vapors are released during operation. In many cases the installation's Clean Air Act permit is sufficient.

The only other issue that must be considered is the disposal of the spent HEPA filters if the filters are deemed hazardous. If the filter is deemed hazardous then the installation must comply with the Resource Conservation and Recovery Act following proper disposal procedures.

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APPENDIX A

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